

## SECTION C Descriptions and Specifications

**STATEMENT OF WORK****1.0 SCOPE**

The Contractor in accordance the statement of work herein, and individual delivery orders issued within the scope of this statement of work, shall provide engineering and technical work described herein in support of the Carderock Division of the Naval Surface Warfare Center.

The engineering and technical work applies to research and development, new designs, construction, conversions, modernization, and fleet support of all surface ships and submarines under Navy cognizance including work performed under Navy cognizance for other U.S. Government agencies or foreign countries.

The work also applies to special studies and programs in the naval engineering field as well as development and update of technical directives, standards, specifications, design data sheets, instructions, and drawings under the cognizance of the Naval Surface Warfare Center, Carderock Division (NSWCCD).

Work will be accomplished as specified in written delivery orders (DD Form 1155s) and will encompass the following fields and disciplines of Naval Engineering:

**1.1 Deck and Replenishment Systems**

- Amphibious, boat, vehicle, and cargo handling systems
- Aircraft support systems
- Ocean engineering and ship handling systems
- Underway replenishment systems and components
- Anchoring, towing, and moorings systems

**1.2 Deck machinery and Hull Outfitting**

- Elevators, (cargo, weapons, stores, personnel, aircraft)
- Weapons and ordnance handling
- Cranes (boat, aircraft, missile repair)
- Boat handling equipment (booms, winches, davits, cradles)
- Mien sweeping and mine hunting handling equipment
- Conveyors – all types
- Amphibious assault subsystems (stern gates, ramps, hoists monorails)
- Doors, hatches, scuttles, closures
- Non structural bulkheads
- Submarine weapon launch and handling
- Hull Outfit and fittings
- Magazine storage arrangements and fittings

**1.3 Propulsion Systems**

- Steam generation & support systems
- Steam turbines
- Marine Gas Turbines
  - Engines
  - Modules, enclosures, and related equipment
  - Performance and condition monitoring
  - Lube oil, fuel, bleed air systems, and components
  - Intercooled and recuperative engines (ICR)
- Diesel Engines – all speeds
- Other internal combustion engines

- Reduction Gears- all types
  - Shafting systems
  - Couplings, clutches, and brakes
  - Shaft seals
  - Bearings
  - Greases, hydraulic fluids, and lube oils
  - Propellers & propulsors – all types
  - Machinery space arrangements
  - Propulsion plant analyses
  - Electric drive systems and associated machinery
  - Propulsion Operating Guides (POG)
  - Engineering Operating Sequencing Systems (EOSS)
  - Improved Performance Machinery Program (IPMP) components
- 1.4 Auxiliary Systems
- Heating, Ventilation, and Air Conditioning (HVAC) systems
  - Life Support systems
  - Refrigeration systems
  - Cryogenic and gas processes
  - Fluid systems and components
  - Pumps – all types, all applications
  - Compressors and lowers
  - Air systems – all pressures, all applications
  - Valves, fittings, and piping
  - Fasteners
  - Heat exchangers – all types, all applications
  - Cargo (petroleum, oils and lubricants) and ship's fuels systems and Components )
  - Water desalination
  - SUBSAFE systems and components
  - Ocean engineering systems
- 1.5 Electrical
- Electrical distribution systems and equipment
  - Lighting systems
  - Electrical fixtures
  - Cable sand insulation
  - Protective devices
  - Generators
  - Electrical power conversion equipment
  - Motors
  - Magnetic defense (including shore measurement and degaussing)
  - Cathodic protection
  - Batteries
  - Internal communications
  - Electrical system analyses, including harmonics
  - Electrical component installation methods
- 1.6 Control Systems
- Ship control hydraulic systems
  - Steering
  - Diving
  - Fin stabilizers
  - Bow thrusters and position keeping systems
  - Control surfaces (planes, rudders, fins propellers)

- Simulator/stimulator systems
  - Trainer systems and components
  - Sensors
  - Instrumentation
  - Actuators
  - Motor controllers
  - Integrated propulsion control systems and equipment
  - Integrated machinery control systems and equipment
  - Integrated damage control systems and equipment
  - Fiber Optics technologies
- 1.7 Damage Control and Survivability
- Fire threat hazard analysis
  - Fire and smoke spread modeling
  - Fire suppression systems and procedures
  - Acoustic and non-acoustic signature reduction systems and procedures
  - Passive fire protection
  - Fire fighting doctrine, tactics, and procedures
  - Forensic investigation of major shipboard fires, catastrophes and casualties
  - Flooding control
  - Damage prevention
  - Stability assessment
  - Acoustic and non-acoustic signature assessment
  - Personnel protection
  - Systems reconfiguration and repair
  - Damage control training support
  - Personnel protective equipage (PPE)
  - Wash down systems
- 1.8 Ship Structures
- Shell plating
  - Underwater stanchions
  - Framing for shell plating and inner bottoms
  - Structural bulkheads
  - Decks and platforms
  - Superstructure
  - Shaft struts
  - Exhaust gas uptake and stacks
  - Protective plating
  - Masts and spars for surface ships
  - Foundations
  - Submarine/submersible pressure hull structure
  - Submarine/submersible non-pressure hull structure
- 1.9 Ship Specifications and Standards
- General Specifications for Ships of the U.S. Navy (GENSPEC)
  - General Specifications for Overhaul of Surface Ships
  - General Specifications for Overhaul of Submarines
  - Military Specifications (MILSPEC)
  - Federal Specifications (FEDSPEC)
  - Military Standards (MILSTD)
  - Federal Standards (FEDSTD)
  - Design Data Sheets (DDS)
  - Standard and Type drawings

#### 1.10 Integrated Logistic Support

- Maintenance planning
- Support and test equipment
- Supply support
- Packaging, handling, storage and transportation
- Technical data, including drawings and provisioning technical documentation (PTD)
- Technical publications
- Facilities
- Personnel and training
- Computer aided Acquisition Logistic Support (CALS)

#### 1.11 Materials

- Metallic material; including steel, high strength steels, titanium, aluminum, exotic metals
- Castings
- Forgings
- Welding, mechanical fastening, and allied joining processes
- Non-destructive Evaluation/Testing (NDE/NDT)
- Alloy development and steel processing
- Fabrication
- Stress and fracture mechanics
- Radiography, ultrasonic, and eddy current testing
- Non-metallic materials; including plastics, elastomers, composites, wood, ceramics, fibrous glasses, foams
- Damping systems
- Transmission loss treatments
- Insulation systems
- Fabrics and coverings
- Fuels, lubricants, and chemicals
- Chemical formulations and analyses
- Materials, fire, smoke, and toxicity studies
- Asbestos elimination

#### 1.12 Reliability Maintainability, and Quality

- Reliability Maintainability, and Availability (RMA) analysis
- Operational Availability (Ao) determination
- Mission scenarios/design reference missions
- TIGER computer simulation program
- Readiness assessment
- Material Readiness Data Base (MRDB)
- Material Readiness Improvement Program (RIP)
- Material Readiness Based Sparing (RBS)
- Statistical process control
- Quality assurance engineering
- Quality audits/surveys/reviews
- Qualified Services Lists (QSL)
- Qualified Products List (QPL)

#### 1.13 Naval Architecture

- Hull form
- Stability
- Weights
- Mass properties
- General Arrangements

Habitability

Manning

- Human Factors engineering and system safety
- Hydronamic and aerodynamic performance
- Appendages
- Control surfaces
- Airflow and stack gas dispersion
- Speed-Power performance analyses
- Seakeeping and maneuvering
- Hydrodynamic loads and hydro elasticity
- Propulsor integration

#### 1.14 Environmental Engineering and Pollution Control

- Solid Waste management/treatment/handling/disposal (including plastics)
- Sewage treatment/handling/disposal
- Oily waste treatment/disposal
- Contaminated fluids
- Chlorofluorocarbons (CRCs) elimination/replacement
- PCB elimination
- Hazardous waste
- United States and international laws and regulations
- Shipboard environmental policy
- Medical waste management
- Air pollution
- Noise pollution
- Thermal pollution
- Afloat Navy occupational Safety and Health (NAVOSH) program

#### 1.15 Ship System Integration

- Computer aided design (CAD)
- Feasibility analyses
- System optimization
- System interface control
- Configuration control
- Space/compartment arrangements
- Design budget and margins
- Tradeoff studies and analyses
- Technical risk assessment

#### 1.16 Machinery Condition Assessment

- Reliability centered maintenance (RCM)
- Sensors and instrumentation
- Fiber optic
- Duty cycles
- Trend analyses
- Repair forecasting

#### 1.17 Acoustic Engineering Submarines and Surface Ship

- Ship silencing
- Noise and vibration control
- Acoustic trials
- Hull treatment and baffles
- Interior treatments

#### 1.18 Ship Habitability Systems and Equipment

Berthing  
Sanitary  
Galley  
Scullery  
Messing  
Laundry  
Dry Cleaning  
Office  
Library  
Lounge  
Wardroom Spaces

## **2.0 STATEMENT OF WORK**

The contractor, as required by individual delivery orders, shall provide non-personal engineering and technical services as described below. This work will cover naval ship engineering and technical support (both surface ships and submarines).

Feasibility Studies  
Preliminary Design  
Contract Design  
Detail Design and Drawings  
Engineering Change Proposal Development  
Material Selection and Fabrication  
Producibility Studies/Value Engineering Studies  
Survivability Studies  
Standardization/Reverse Engineering  
Independent Design Reviews  
Failure Modes and Effect Analyses  
Special Studies  
Ship Systems Integration  
Reliability/Maintainability Analyses  
Integrated Logistics Support  
Test and Evaluation  
Shipboard Installation Support  
Drawing Preparation and Review  
Modeling  
Structures  
Configuration Management  
Specifications and Standards

**2.1** The following specific requirements are provided as definition of the work described above:

a. **Feasibility Studies**

Feasibility studies provide an impact analysis of hull, mechanical and electrical systems on Navy ships and submarines with a minimum amount of data/information.

Deliverables from such studies are limited in detail/specifies and provide broad overviews and general conclusions.

Efforts will be required to gather interface data, background data and information, to analyze the impact of the desired capabilities, characteristics and features. Feasibility studies are used for both new ship designs and back fit or conversion of older ships.

Feasibility study investigations associated with hull, mechanical, and electrical (HM&E) systems are more than just the definition and identification of the impact on the systems themselves. The investigations must be comprehensive and identify changes that may affect ship size, signatures, major equipment selection, arrangements, location, and size of main equipment rooms, desired ship/system performance, or to determine services safety, manning and security requirements.

**b. Preliminary Design**

Preliminary design activity comprises the development required to provide an engineering description of the ship and each major subsystem in terms of very rough system diagrams, layout drawings, and performance characteristics. Tradeoff studies are accomplished to refine subsystem definitions and to provide a basis for the rational selection of major components. The preliminary design must achieve a complete engineering description of an integrated ship system so that the basic ship size and definition will not change during contract design.

The contractor will provide preliminary design technical and engineering support. Specific baseline requirements to be used in each preliminary design task will be defined by the issuance of the delivery order upon initiation of the design.

The following documents are typical of those that are used to define the baseline for preliminary design which may be furnished to the contractor:

- (1) Feasibility Reports
- (2) Conceptual Design Reports
- (3) Top level Requirements (TLR)
- (4) Ship Characteristics
- (5) Preliminary System Performance Requirements
- (6) Interface Requirements
- (7) Safety and Security Considerations

In the development of the preliminary design of various HM&E systems, the contractor may be tasked to perform any of the following:

- (1) Definition of baseline
- (2) Establishment of design criteria and sources
- (3) Collection of interface data, information, and requirements
- (4) Conduct studies, analyses and investigations
- (5) Preparation for design development reports
- (6) Review of interface documentation
- (7) Providing status of design development reports
- (8) Presentation of design development
- (10) Documenting the design development

**c. Contract Design**

During contract design, the results of the preliminary design must be validated. Contract design effort encompasses the preparation of the drawings and specifications required to provide an information package sufficiently detailed for negotiation of a construction contract with a shipbuilder. The quality of this product is of prime concern and the drawing and specifications must be prepared with care and checked thoroughly to ensure that they describe what is wanted clearly and concisely.

The contractor will provide contract design technical and engineering support. The various HM&E systems preliminary design deliverables, preliminary design reports, unresolved items, and Top Level Specifications and other documents, basically establish the starting point for a contract design. Shortly following the start of the contract design, a baseline is established by the Government and configuration control is initiated. This control requires formal submission and approval of any changes.

In the development of the various portions of contract designs, the contractor may be tasked to do any of the following:

- (1) Define system baseline and develop criteria
- (2) Conduct special studies
- (3) Develop study sketches, calculations notes, and study drawings
- (4) Develop contract guidance drawings
- (5) Develop specification sections and inputs to various interfacing specification sections
- (6) Develop system development change reports
- (7) Develop a master equipment list (MEL) for machinery systems
- (8) Develop configuration change requests, as necessary
- (9) Review interfacing documents and comment as requested
- (10) Participate in and assist during circulation and review of the ship specification and adjudication of comments thereto and in preparation for and assistance during ship specification reading sessions
- (11) Develop design histories
- (12) Maintain design notebooks
- (13) Develop specific design documentation and reports
- (14) Assist in the design reviews of the preliminary design effort and resolve comments and recommendations
- (15) Hold scheduled progress meetings to discuss specific problem areas

Upon receipt of a specific system review package, two distinct reviews may be required of the contractor:

- (a) Administrative – This review ascertains that the submitted system review package contains all documents required by the detail ship specifications and Contract Data Requirements List (CDRL) and that each document is properly formatted. Drawings, system descriptions, calculations, normally have format requirements in the detail ship specifications. To perform this review, a format/content check-off list is developed that could be used for each system. The list contains as individual line items, the format/content requirements from each of the detail ship specifications, identifying specification sections, page and line number(s).
- (b) Design – This review ascertains that the submitted system review package meets the technical requirements of the detail ship specifications. AS such, it is a review of the system drawings and/or calculations as developed by the design agent with respect to specific system detail ship specification sections and to interface detail ships specification sections. To perform this review, comments are provided in the form of:
  - (1) Marked up drawings
  - (2) Lists of drawing errors
  - (3) Lists of drawing omissions
  - (4) Lists of review documents errors
  - (5) Responses to special instructions

d. **Detail Design**

Detail design support for new construction lasts until the ship is completed and delivered to the Navy. It can also be defined as provision of any detail drawing support (level II drawings) throughout the life cycle of a ship.

The preliminary detail design support to be provided by the contractor will involve the review and approval (within specified timeframes) of various drawings (system diagrammatic, arrangements) and associated supporting documentation prepared by the design agent (or his subcontractors) and submitted to Naval Surface Warfare Center, Carderock Division (NSWCCD). The drawings submitted for NSWCCD review and approval by the design agent also include:

- (1) Ship builder-forwarding letter
- (2) Supervisor of Shipbuilding (SOS) forwarding letter, with or without comments
- (3) System Description



#### (4) System and equipment calculations

The following documents are used to define the base line ship for which detailed design support efforts may be required by the contractor:

- (1) Detail ship specifications with all changes (HMR's, FMR's and modifications thereto)
- (2) Contract Data Requirements List
- (3) Contract and Contract Guidance Drawings
- (4) Study Drawings (if available)
- (5) Military Standard MIL-STD-7677 and the applicable revision thereto
- (6) Contract Design Change Reports, Preliminary Design Development Reports, and/or Impact Analysis Report (if available)
- (7) Contract Design and Preliminary Design histories (if available)
- (8) Contract Design and Preliminary Notebooks (if available)

The number and type of hull, mechanical and electrical systems involved in detail design support efforts are a function of the particular ship detail specifications.

#### e. **Engineering Change Proposal Development**

During the period of detailed design development, changes and improvements of various design aspects may become necessary. These can result from directed changes in basic requirements or from discrepancies in specifications or contract design drawings. In most cases, these changes and improvements will be implemented by Engineering Change Proposal (ECP) procedures established by the ship acquisition manager.

In support of development of the detail design changes and improvements. The contractor may receive tasks to perform any of the following:

- (1) Identification, during detailed design review, if changes, and improvements that may require ECP action.
- (2) Development of preliminary ECP's for review and comment
- (3) Participation in preliminary ECP review meetings
- (4) Development of final ECP
- (5) Review of resulting detail design changes developed in response to an approved ECP

#### f. **Materials Selection and Fabrication**

Provide engineering and program support in the areas of material engineering, and materials quality assurance and reliability. Work consists of specification development and revision, evaluation of new material, recommendation/selection of material for specific applications, testing of selected materials (both destructive and non-destructive), failure analyses, and fabrication and joinh techniques, among others.

#### g. **Producibility Studies/Value Engineering Studies**

Conduct producibility and value engineering studies on various HM&E systems and equipment, identifying and evaluating alternatives in designs which could reduce construction and/or fabrication costs or time. Identify and evaluate changes in ship materials, equipment, or configuration which have potential construction cost savings and favorable impact upon weight or performance. Identify changes which would reduce maintenance burden or reduce numbers of parts thereby enhancing utility over the life cycle.

#### h. **Survivability Studies**

Develop survivability studies for hull, mechanical and electrical systems and equipment. Develop survivability/vulnerability methodology, perform ship and submarine vulnerability model studies, develop and assess shock hardening techniques, acoustic and non-acoustic signatures, investigate fire and damage control aspects as they apply to ship survivability, and weapons effects, both conventional and nuclear. As necessary, the efforts will involve consideration of ballistic effects, thermal effects, electromagnetic pulse(EMS0, nuclear air blast, underwater shock, and radiological, chemical, and biological warfare.

Investigations and studies will involve total ship survivability, system and subsystem survivability, and defense mechanisms.

i. **Standardization and Reverse Engineering**

Develop Navy-owned designs for HM&E equipment including (as appropriate) reverse engineering (forensic analysis of existing equipment for materials, fabrication techniques, dimensioning, and tolerancing). Unique designs will be produced for individual equipment or families of equipment, including but not limited to a series of fire pumps, winches, or valves with differing capacities.

j. **Independent Design Reviews**

Participate in independent design reviews involving in-depth investigation and analysis of a system, subsystem, or equipment for the purpose of identifying problem areas, technical deficiencies, and recommended design solutions. AN independent design review team is usually composed of a varied team of government employees, industry representative, and support contractors who have sufficient expertise to conduct the analyses. Reviews will encompass examination of top level requirements and specifications, reliability, maintainability, and availability data, suitability of equipment/system for intended purpose, operational characteristics, human factors, safety, cost, size, and weight. At the conclusion of an independent design review, prepare a comprehensive report of findings and recommendations including redesign proposals as appropriate.

k. **Failure Modes and Effect Analyses**

Conduct failure modes and effects analyses and prepare appropriate reports. A failure modes and effect analysis is an organized procedure for identifying, evaluating, and analyzing all known potential failure modes for the equipment/system in question, together with the causes and the proposed actions to inhibit such failures or reduce their criticality. All detection mechanisms and backup means of operation for a given failure mode shall be identified. For all single-point failure modes (where no redundancy exists in the design), any compensating provisions, such as failure indicators, fail-safe features, securing mechanisms, and alarms shall be identified. Where there are no compensating provisions, justification shall be provided for their lack or adequate compensating provisions recommended.

l. **Special Studies**

The contractor may be tasked to perform special studies on HM&E systems and equipment. These studies involve the solution of problems that degrade the operational performance of hull, mechanical and electrical systems, and relate equipment which go beyond the narrow scope of technical changes and product improvements. Solutions will consider improvements in shipboard operator/maintainer training, integrated logistic support documentation, spare parts support, and repair recommendations. Such non-technical improvements may be accomplished in conjunction with or as alternatives to product improvements. Solution development involves interim as well as long term (or final) fixed. The contractor will be required to prepare appropriate reports.

m. **Ship Systems Integration**

Perform ship systems integration. Ship systems integration is the amalgamation of the principal design products and trade-offs studies during ship design process into a design package that synthesizes all HM&E subsystems into a total ship system. In this process, all technical aspects of the design are required to be coordinated, configuration control managed, new technologies prioritized and evaluated from a risk/reward basis, and inconsistencies or incompatibilities between ship subsystems resolved. Ship system integration task may also be assigned during ship modernization and conversion.

n. **Reliability/Maintainability Analyses**

Provide support for the development, implementation, and maintenance of an engineering database consisting of equipment operating times; Reliability, Maintainability and Availability (R/M/A) data; Configuration Management and Maintenance. This effort includes collection and development of engineering data, and providing the data in reports which identify equipment configuration, repair/failure history, maintenance projections, and R&M projections. The data base is sufficiently adequate for projecting requirements for spare engines, depot repair projections, modification kit requirements, special

support equipment and systems stock planned program requirements. Develop and provide maintenance plans with schedules identifying periodic inspection and maintenance actions required by the maintenance projections.

o. **Integrated Logistic Support (ILS)**

Provide support in all areas of ILS for HM&E systems and equipment and prepare supporting documentation. ILS is the composite of all support considerations necessary to assure the effective and economical support of a system or equipment for its programmed life cycle. Logistic elements include all requirements and resources necessary to operate and maintain the system or equipment at all levels of support (organizational, intermediate, and depot). The elements to be addressed are:

- Maintenance planning;
- Support and test equipment;
- Supply support;
- Packing, handling storage transportation;
- Technical data (including drawings);
- Technical publications;
- Facilities;
- Personnel and training

p. **Test and Evaluation**

Conduct testing of ship HM&E systems and equipment. Tests may be either shore based or on board ship and are conducted for the purpose of demonstrating compliance with published specifications, drawings, and demonstrating attributes such as workmanship, alignment, strength, rigidity, tightness, and suitability for the purpose intended. During these tests, the instrumentation, and personnel to conduct each test. Appropriate documentation, test plans, test agenda, and test reports will be prepared by the contractor.

Participate in various ship trials. These trials include Acceptance Trials, Final Contract Trials, Standardization Trials, Vibration Trials, Machinery Performance Trials, Dock Trials, Shock Trials, and other special trials.

Perform specific scientific, operational, and physical test and evaluations in support of developmental items which may be the subject of specific delivery orders.

q. **Shipboard Installation Support**

Provide support for various HM&E system and equipment installations on new construction, active and inactive fleet ships. This involves on board technical support during installation with redesign and documentation revisions as appropriate. Alignment and calibration support may be involved as well as trouble-shooting and testing.

r. **Drawing Preparation and Review**

Develop and produce the following various kinds of ship design drawings in accordance with the appropriate MILSPECS and MILSTDS:

- Ship design drawings;
- Ship construction drawings;
- Selected record drawings;
- Installation control drawings;
- Ship equipment drawings (including outline drawings assembly drawings, subassembly drawings and parts lists);
- Non deviation drawings;
- Standard and type drawings;
- Project peculiar documents

Provide appropriate levels of review of any such drawings. Reviews may be required for format, technical feasibility, dimensioning and tolerancing, producibility, technical accuracy, or any combination of the foregoing.

s. **Modeling**

In support of certain engineering tasks, construct feasibility models or mock-ups of various ship systems and equipment and assemble items or developmental equipment for shipboard tests and simulations. This includes electrical bread boarding, scale study models of handling equipment, compartment arrangement models. Extensive use of computer aided design and simulation is anticipated.

t. **Structures**

Provide total spectrum ship structural design support for all phases of a total ship design including design criteria, hull loading, structural arrangements, stress analysis, scantling size, and specifications. Perform detailed structural analyses requiring a working knowledge of the following computerized structural analysis programs: NASTRAN; STRUDL; SHCP; and others.

Perform analyses in specialized structural problem areas such as floating dry dock design and certification, foundation design, material assessment, and welding analysis and certification.

Develop total ship or submarine structural design from feasibility studies through contract design. Computerize various structural design processes such as Design Data Sheets.

Provide structural support for active fleet ships and submarines including SHIPALT development, emergency damage assessment and repair recommendations, and modernization designs.

u. **Configuration Management**

The contractor shall provide technical and engineering services in support of configuration management. Configuration management is a discipline that integrates the technical and administrative actions of identifying the functional and physical characteristics of an item during its life cycle, controlling changes to those characteristics and providing information on the status of change actions. Configuration Management is comprised of three major areas of effort: identification; control and status accounting. The contractor will provide technical support for configuration management in all phases of the life cycle of a configuration item. This entails conducting configuration audits, identifying items, establishing and maintaining databases, engineering change proposal preparation and tracking, participation in technical reviews, and preparing of appropriate reports.

v. **Specifications and Standards**

Provide technical support for development of NAVSEA specifications and standards documentation including General Specifications for Ships of the U.S. Navy (GENSPECS), Ship Specifications (based upon GENSPEC extraction), equipment specs, DOD standardization documents (MILSTD/DODSTD), NAVSES Standard and Type drawings, Design Data Sheets, & Ship Design Standards.

The support will require performing engineering analyses of technical feedback documents, preparing specifications section proposed amendments, maintaining data files, and technical review for consistency and coverage.